ACTA BIOL. SZEGED. 39. pp. 109-111 (1993)

Short communication

CORRELATION BETWEEN THE SALT-EXTRACTABLE, CELL WALL-BOUND PEROXIDASE ACTIVITIES AND THE ETHYLENE PRODUCTION IN THE PULVINI AND PETIOLES OF PACLOBUTRAZOL-TREATED BEAN PRIMARY LEAVES

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(Received: April 26, 1993)

Abstract

Paclobutrazol [(2RS,3RS)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl)pentan-3-ol], a triazole growth retardant increases ethylene production in the secondary pulvinus and stalk of the 14-day-old bean primary leaves but not that of the primary pulvinus. Salt-extractable, cell wall-bound peroxidase activities correlated with the ethylene production of the tissues.

Key words: ethylene production, *Phaseolus vulgaris* L. *cv. Juliska*, primary leaf petiole, pulvini, salt extractable, cell wall-bound peroxidase activity.

Plant growth retardants, the chemicals which induce dwarfism, block the biosynthesis of gibberellins, inhibit ethylene production (SAUERBREY et al., 1987; GROSSMANN, 1990) and increase peroxidase activity (HALEVY, 1963; FRY, 1979; UPADHYAYA et al., 1991) in several systems. A dwarf phenotype of pea with impaired synthesis of gibberellic acid$_1$, the active gibberellin in tall plants, has higher soluble and salt-extractable wall-bound peroxidase activities in the internodes than the slender phenotype which has long and thin internodes (JUPE and SCOTT, 1989). Gibberellic acid is supposed to suppress peroxidase activity in the cell walls and prevents the peroxidase-catalysed coupling of phenols between the cell wall polymers (FRY, 1986). High degree of cross-linking between wall polymers results in tight cell walls incapable for rapid cell expansion. Gibberellic acid also inhibits peroxidase secretion into the apoplast (FRY, 1980). The secreted protein molecules may ionically or covalently bound to the cell wall polymers.

RIDGE and OSBORNE (1970) found that exogenously applied ethylene increased the ionically bound fraction of peroxidases in the walls ot etiolated pea epicotyls and the hormone induced an increase in acidic peroxidase level in the cell wall of Bryonia dioica (BOYER and GASPAR, 1980).

Paclobutrazol [(2RS,3RS)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl)-pentan-3-ol], a triazole growth retardant may inhibit (WANG and STEFFENS, 1985) or increase (NAGY and TARI, 1991) the ethylene production of plant tissues. Paclobutrazol is known to inhibit biosynthesis of gibberellins (GROSSMANN, 1990) but not necessarily reduces the gibberellic acid content in the whole plant (NAGY, personal communication), as it was found in case of other retardants (GROSSMANN et al., 1987; NAGY and TARI, 1987). Therefore, we may not exclude a tissue-specific involvement of ethylene in peroxidase secretion in paclobutrazol treated bean plants.

Table 1. Ethylene production in petiole parts of 14-day-old bean primary leaves treated with 8.5 μM paclobutrazol. Seeds were soaked in 8.5 μM paclobutrazol solution and seedlings were grown in garden mould under controlled conditions. Ethylene was determined by gas chromatography in 2.5 cm^3 samples withdrawn from the gas space above the plant material enclosed in 6 ml tubes after 1 h incubation. (Means SE, n=5)

Tissue	Ethylene production (nl· fresh $weight^{-1}·g^{-1}·h^{-1}$)	
	Control	Treated
secondary pulvinus	0.732±0.046	1.600±0.120
stalk	1.174±0.124	1.958±0.108
primary pulvinus	1.666±0.327	1.659±0.143

Table 2. Salt-extractable, cell wall-bound peroxidase activity in the petiole parts of 14-day-old bean primary leaves treated with 8.5 μM paclobutrazol. Ionically bound peroxidases were extracted with 1 mM NaCl in 66 mM phosphate buffer (pH=6.2) from the pellet of tissue homogenate after the extraction of soluble peroxidases. Peroxidase activity was determined as the maximal initial rate of the increase in absorbance at 470 nm with guaiacol as a substrate by the method of JUPPE and SCOTT (1989). (Means±SE, n=3).

Tissue	Peroxidase activity (Guaiacol oxidized (μM)·$sec^{-1}·FW^{-1}·g^{-1}$)	
	Control	Treated
secondary pulvinus	39.01±0.56	44.25±1.13
stalk	6.95±1.86	14.82±1.73
primary pulvinus	23.46±1.68	24.06±1.07

We found higher ethylene production in the secondary pulvinus and stalk of primary leaves of 14-day-old bean (*Phaseolus vulgaris* L. *cv. Juliska*) treated with 8.5 μM paclobutrazol than in the control but in the first pulvinus there was no enhancement in the ethylene level (Table 1).

Ionically-bound peroxidase activities in the apoplast of the stalk and pulvini were correlated to the ethylene production of the tissues (Table 2). The relationship between ethylene action and peroxidase secretion demands further elucidation.

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